

WHAT IS CLAIMED IS: /

1. A scanning optical system comprising:

a scanning device which scans light from a light source,
and

a first optical system which directs the light scanned
by the scanning device to an exit pupil, wherein

the first optical system comprises a first surface and
a second surface, the first surface having at least a
reflective action and being decentered with respect to a
central principal ray, the second surface again reflecting
light reflected by the first surface toward the first
surface, and wherein

the first surface reflects the central principal ray,
which has again been made incident to the first surface from
the second surface, toward a side substantially opposite to
a side toward which the central principal ray was reflected
the last time with respect to a normal on a hit point of the
central principal ray on the first surface.

2. The scanning optical system according to Claim 1,
wherein

the first optical system further comprises a third
surface in which a reflective area and a transmissive area
are formed, the transmissive area allowing the light from
the scanning device to be made incident into the first

optical system, and wherein

the transmissive area is smaller in area than the reflective area.

3. The scanning optical system according to Claim 1, wherein

the first optical system makes the light from the scanning device form an intermediate image, and

a diffuse-reflective surface serving as the second surface is disposed at one of the positions of the intermediate image and in the vicinity of the intermediate image.

4. The scanning optical system according to Claim 1, wherein

the first optical system further comprises a third surface, and the third surface reflects light which has proceeded from a first optical path including a first reflection on the first surface to a second optical path including a reflection on the first surface after being reflected by the second surface, thus forming an optical path differing from the first optical path.

5. The scanning optical system according to Claim 1, wherein

the first optical system makes the light from the scanning device form an intermediate image, and

the scanning device is disposed at a position conjugated with the exit pupil, and the light from the scanning device forms a two-dimensional image at a position of the intermediate image.

6. The scanning optical system according to Claim 1, wherein

the scanning device is formed of a reflective member scannable in a two-dimensional direction.

7. A scan type image display apparatus comprising:
the scanning optical system according to Claim 1; and
a drive circuit which drives the scanning device.

8. An image display system comprising:
the scan type image display apparatus according to Claim 7; and

an image-information supply apparatus which supplies image information to the image display apparatus.

9. An scanning optical system comprising:
a scanning device which scans light from a light source; and

a first optical system which directs the light scanned by the scanning device to an exit pupil,

wherein the first optical system comprises a decentered surface which is decentered with respect to an optical path of the light, and the first optical system reflects the light on the decentered surface a plurality of times, and wherein

the first optical system has a case where an inner product between outer products each formed by vectors of incident light and reflected light in the respective reflections performed the plurality of times is negative.

10. The scanning optical system according to Claim 9, wherein

the first optical system further comprises a third surface in which a reflective area and a transmissive area are formed, and the transmissive area allows the light from the scanning device to be made incident into the first optical system, and wherein

the transmissive area is smaller in area than the reflective area.

11. The scanning optical system according to Claim 9, wherein

the first optical system makes the light from the

scanning device form an intermediate image, and

a diffuse-reflective surface serving as the second surface is disposed at one of the positions of the intermediate image and in the vicinity of the intermediate image.

12. The scanning optical system according to Claim 9, wherein

the first optical system further comprises a third surface, and the third surface reflects light which has proceeded from a first optical path including a first reflection on the first surface to a second optical path including a reflection on the first surface after being reflected by the second surface, thus forming an optical path differing from the first optical path.

13. The scanning optical system according to Claim 9, wherein

the first optical system makes the light from the scanning device form an intermediate image, and

the scanning device is disposed at a position conjugated with the exit pupil, and the light from the scanning device forms a two-dimensional image at a position of the intermediate image.

14. The scanning optical system according to Claim 9, wherein

the scanning device is formed of a reflective member scannable in a two-dimensional direction.

15. A scan type image display apparatus comprising:

the scanning optical system according to Claim 9; and
a drive circuit which drives the scanning device.

16. An image display system comprising:

the scan type image display apparatus according to Claim 15; and

an image-information supply apparatus which supplies image information to the image display apparatus.

17. A scanning optical system comprising: /

a scanning device which scans light from a light source; and

a first optical system which directs the light scanned by the scanning device to an exit pupil, wherein

the first optical system comprises a first surface and a second surface, the first surface having at least a reflective action and being decentered with respect to a central principal ray, the second surface again reflecting the light reflected by the first surface toward the first

surface, and wherein

the first surface reflects the central principal ray, which has again been made incident to the first surface from the second surface, toward a side substantially opposite to a side toward which the central principal ray was reflected the last time with respect to a normal on a hit point of the central principal ray on the first surface,

the second surface has a diffusing and reflecting action, and

the first optical system makes the light form an intermediate image either on the second surface or in the vicinity of the second surface.

18. The scanning optical system according to Claim 17, wherein

the first optical system further comprises a third surface, and the third surface reflects light which has proceeded from a first optical path including a first reflection on the first surface to a second optical path including a reflection on the first surface after being reflected by the second surface, thus forming an optical path differing from the first optical path.

19. The scanning optical system according to Claim 17, wherein

the first optical system comprises a transparent body in which at least three surfaces including a plurality of rotationally asymmetric reflective surfaces are formed.

20. The scanning optical system according to Claim 19, wherein,

in each of the plurality of rotationally asymmetric reflective surfaces, an absolute value of a focal length in a local generatrix section is larger than an absolute value of a focal length in a local directrix section.

21. A scan type image display apparatus comprising:

the scanning optical system according to Claim 17, and
a drive circuit which drives the scanning device.

22. An image display system comprising:

the scan type image display apparatus according to Claim 21, and

an image-information supply apparatus which supplies image information to the image display apparatus.

23. A scanning optical system comprising:

a scanning device which scans light from a light source; and

a first optical system which directs the light scanned

by the scanning device to an exit pupil,

wherein the first optical system comprises a first surface which is decentered with respect to an optical path and a second surface which has a diffusing and reflecting action,

the first optical system reflects the light on the first surface a plurality of times via reflections on the second surface,

the first optical system has a case where an inner product between outer products each formed by vectors of incident light and reflected light in the respective reflections performed the plurality of times is negative, and

the first optical system makes the light form an intermediate image either on the second surface or in the vicinity of the second surface.

24. The scanning optical system according to Claim 23, wherein

the first optical system further comprises a third surface, and the third surface reflects light which has proceeded from a first optical path including a first reflection on the first surface to a second optical path including a reflection on the first surface after being reflected by the second surface, thus forming an optical

path differing from the first optical path.

25. The scanning optical system according to Claim 23, wherein

the first optical system comprises a transparent body in which at least three surfaces including a plurality of rotationally asymmetric reflective surfaces are formed.

26. The scanning optical system according to Claim 25, wherein,

in each of the plurality of rotationally asymmetric reflective surfaces, an absolute value of a focal length in a local generatrix section is larger than an absolute value of a focal length in a local directrix section.

27. A scan type image display apparatus comprising:

the scanning optical system according to Claim 23; and
a drive circuit which drives the scanning device.

28. An image display system comprising:

the scan type image display apparatus according to Claim 27; and

an image-information supply apparatus which supplies image information to the image display apparatus.

29. A scanning optical system comprising:

a scanning device which scans light from a light source; and

a first optical system which directs the light scanned by the scanning device to an exit pupil,

wherein the first optical system comprises a plurality of rotationally asymmetric first reflective surfaces, and a second reflective surface,

the plurality of first reflective surfaces are decentered with respect to an optical path and face each other,

the second reflective surface has a diffusing and reflecting action,

the first optical system makes the light form an intermediate image either on the second reflective surface or in the vicinity of the second reflective surface, and

the first optical system guides light reflected by the second reflective surface to the exit pupil so as to form an enlarged image.

30. The scanning optical system according to Claim 29, wherein

the first optical system includes a plurality of shared surfaces which are shared between an optical path from the scanning device to the position of the intermediate image

and an optical path from the position of the intermediate image to the exit pupil .

31. The scanning optical system according to Claim 30, wherein

the plurality of shared surfaces are rotationally asymmetric reflective surfaces.

32. The scanning optical system according to Claim 30, wherein

the first optical system comprises a transparent body in which at least three surfaces including the plurality of shared surfaces are formed, and

the second reflective surface is formed independently of the transparent body.

33. The scanning optical system according to Claim 31, wherein,

in each of the plurality of rotationally asymmetric reflective surfaces, an absolute value of a focal length in a local generatrix section is larger than an absolute value of a focal length in a local directrix section.

34. A scan type image display apparatus comprising:

the scanning optical system according to Claim 29; and

a drive circuit which drives the scanning device.

35. An image display system comprising:

the scan type image display apparatus according to Claim 34; and

an image-information supply apparatus which supplies image information to the image display apparatus.

36. A scanning optical system comprising: ✓

a scanning device which scans light from a light source; and

a first optical system which directs the light scanned by the scanning device to an exit pupil, wherein

the first optical system comprises a plurality of surfaces including reflective surfaces,

a reflective area and a transmissive area are formed in the reflective surface, the transmissive area allowing the light from the scanning device to be made incident into the first optical system, and wherein

the transmissive area is smaller in area than the reflective area.

37. The scanning optical system according to Claim 36, wherein

the first optical system makes the light from the

scanning device form an intermediate image, and,

in the first optical system, a diffuse-reflective surface is disposed at one of the positions of the intermediate image and in the vicinity of the intermediate image.

38. The scanning optical system according to Claim 36, wherein

the scanning device is disposed at a position conjugated with the exit pupil, and the light from the scanning device forms a two-dimensional image at a position of the intermediate image.

39. The scanning optical system according to Claim 36, wherein

the first optical system comprises a plurality of rotationally asymmetric reflective surfaces.

40. The scanning optical system according to Claim 36, wherein

an area of the transmissive area is 10% or less of an area of the reflective area.

41. The scanning optical system according to Claim 39, wherein,

in each of the plurality of rotationally asymmetric reflective surfaces, an absolute value of a focal length in a local generatrix section is larger than an absolute value of a focal length in a local directrix section.

42. The scanning optical system according to Claim 36, wherein

a conjugate image of the exit pupil is formed either on the transmissive area or in the vicinity of the transmissive area.

43. A scan type image display apparatus comprising:

the scanning optical system according to Claim 36; and
a drive circuit which drives the scanning device.

44. An image display system comprising:

the scan type image display apparatus according to Claim 43; and

an image-information supply apparatus which supplies image information to the image display apparatus.